

Enhancing SNOMED CT Based Clinical Data Entry via Doctor Desk^{LITE}

A Case Study on Indian HMIS

(Proposal ID 201910)

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A Scientific Society Of the Ministry of Electronics & Information Technology, Government of India

Outline

1. About CDAC & Health Informatics Solutions by CDAC
2. Prior Scenario - Before Doctor Desk^{LITE}
3. Doctor Desk^{LITE} - Need and Motivation
4. Doctor Desk^{LITE} - Web Interfaces & Features
5. Lab Reports Trends Analyzer
6. Prescription Upload Interfaces
7. Voice-Based Prescription Generation System
8. Mobile/Tablet Interfaces with Voice Support
9. Implementations of Doctor Desk^{LITE}
10. AIIMS Mangalagiri - Results from a Case Study
11. Conclusions and Future Work

About CDAC

- An autonomous Research and Development organization under the Ministry of Electronics and Information Technology (MeitY), Government of India.



National Resource Centre
for EHR Standards



Key Focus Areas of CDAC Noida

Health
Informatics

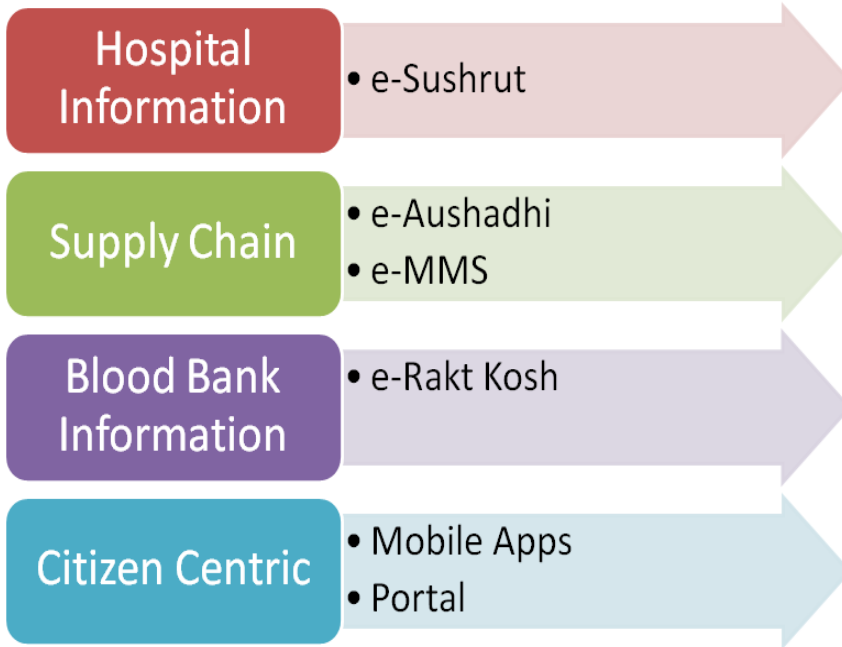
Embedded
Systems

Speech and
Natural Language
Processing

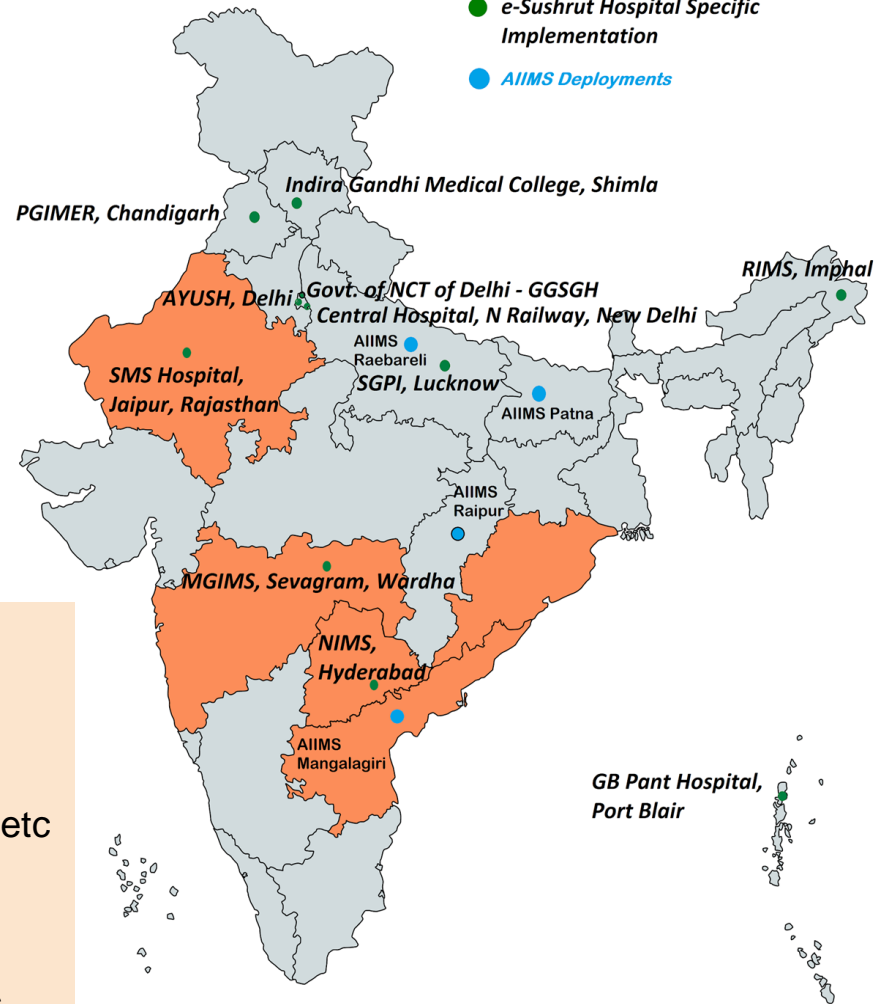
e-Governance

Education and
Training

Health Informatics Solutions by CDAC

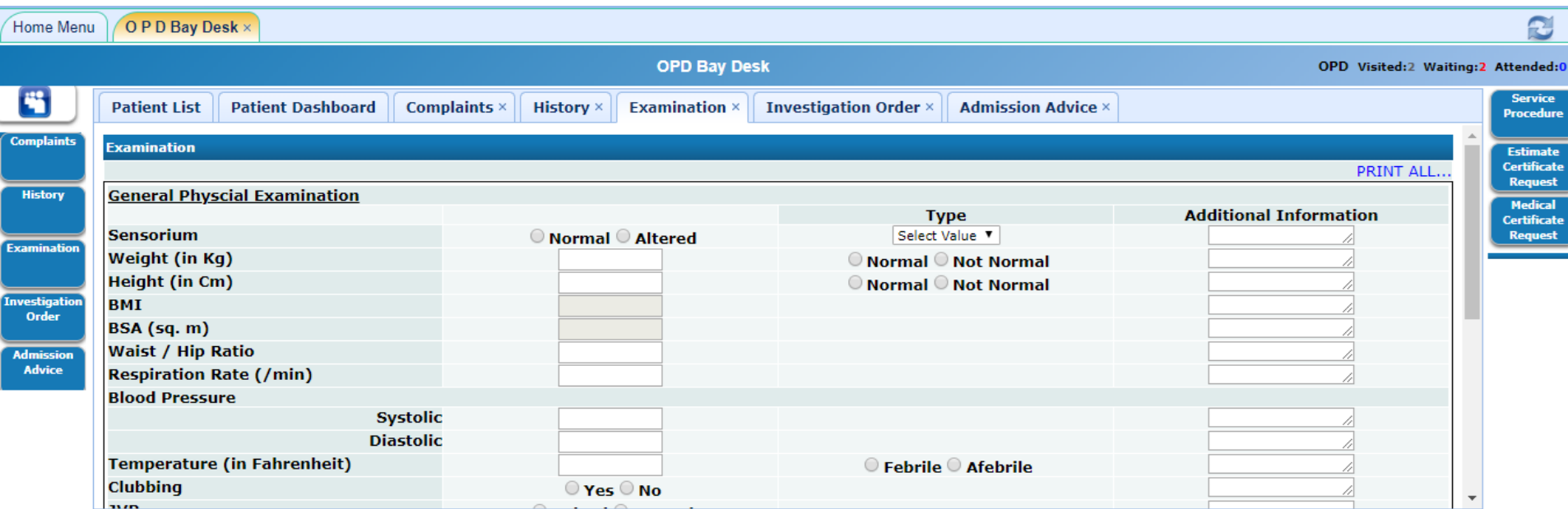


- e-Sushrut State-wide Implementation
- e-Sushrut Hospital Specific Implementation
- AIIMS Deployments



- Available in Open Source Technology
- Configurable for multiple hospitals
- Unique Health ID for patients with patient profiling and EMR generation
- Interface with Medical Equipments, Biometrics, Tablets etc
- Integration with Aadhaar card and SMS Gateway
- Integration with “Mera Aspataal”, Online Registration System
- Supports Payment Gateway to enable Digital Payments

Prior Scenario - Before Doctor Desk^{LITE}



The screenshot shows the 'OPD Bay Desk' interface. At the top, there are navigation tabs: 'Home Menu', 'OPD Bay Desk', and 'OPD Visited:2 Waiting:2 Attended:0'. Below this, there are sub-tabs: 'Patient List', 'Patient Dashboard', 'Complaints', 'History', 'Examination', 'Investigation Order', and 'Admission Advice'. The 'Examination' tab is active, displaying a 'General Physical Examination' form. The form has columns for 'Type' and 'Additional Information'. The 'Type' column has radio buttons for 'Normal' and 'Not Normal'. The 'Additional Information' column has text input fields. The form includes fields for Sensorium, Weight (in Kg), Height (in Cm), BMI, BSA (sq. m), Waist / Hip Ratio, Respiration Rate (/min), Blood Pressure (Systolic and Diastolic), Temperature (in Fahrenheit), and Clubbing. There are also radio buttons for 'Normal' vs 'Altered' and 'Febrile' vs 'Afebrile'.

nitish erwerew

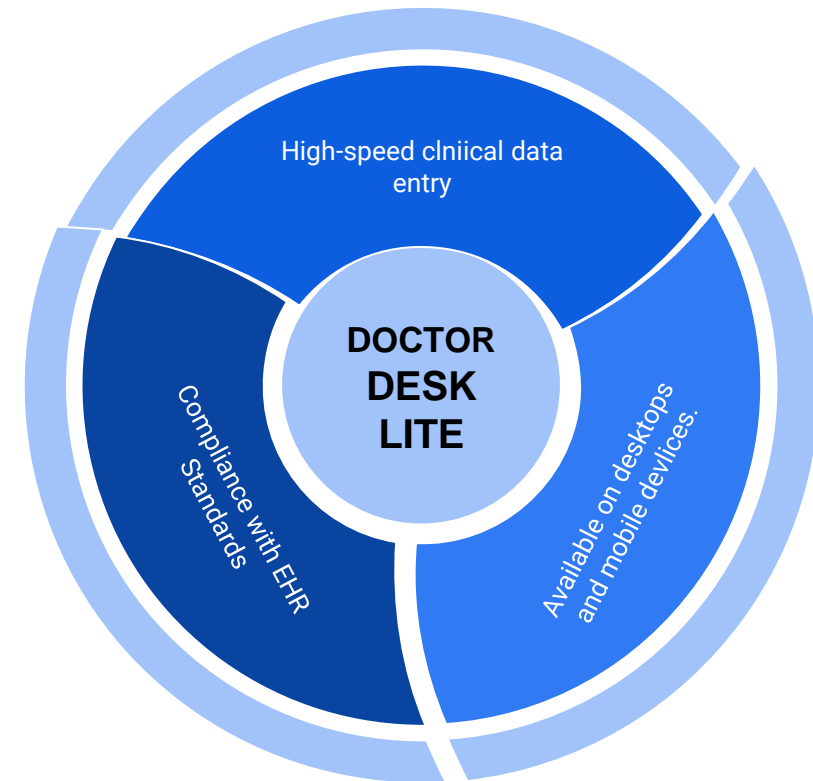
- Doctor Desk (old) interface was available for data entry by clinicians for patient encounters.
- The interfaces were only available on desktops / PC terminals.
- User Interface was not responsive and complicated for use.
- SNOMED CT compliant fields were organized in a non-intuitive manner.
- As a consequence, clinical data entry was only around 10-15% in terms of number of patient encounters.



Doctor Desk ^{LITE}: Need & Motivation



- The primary challenges faced in large-scale adoption of clinical terminology in Hospital Management Information Systems (HMIS) include high patient loads and lack of adequate training to clinicians, particularly in developing countries.
- Clinicians are confounded by complex data entry interfaces present in systems, and often refrain from using them persistently.
- There is a need for simple and effective UI elements in design which is seamlessly accessible on multiple platforms (including mobiles and tablets).
- To this end, we present a case study which establishes the role of effective UI design in facilitating clinical data entry via SNOMED CT.



Doctor Desk^{LITE} Web Interfaces

eSushrut ^{G5}

Welcome, Admin  ₹0.00



Registration **OPD** Investigation Billing Enquiry Admin Radiodiagnosis Service Area Inventory Alert Management Global

Home Menu **OPD Desk Lite Mobile** x



 **DOCTOR DESK**



DEPT/UNIT

Anaesthesiology (Anaesthesiology Unit 1) v

DATE








31 October 2019



0 of 50 attended

Show 50 entries

Search:

Q. No.	Status	Name	Cr. No.	Gen/Age/Cat/Mobile	Dept/Unit	Room No.	Action	Prescription
 11	Waiting	Banna Kukkamalla	379131900148860	F/ 33 Yr/General/7382204129	C F M/C F M Unit 1	02	Rx Vitals/GE	
 9	Waiting	Rama Devi Palagani	379131900085361	F/ 40 Yr/General/9652565398	C F M/C F M Unit 1	02	Rx Vitals/GE	
 2	Attended	Venkata Rajeswari Talasila	379131900144660	F/ 45 Yr/General/9849957891	C F M/C F M Unit 1	02	Rx Reprint	
 5	Waiting	Mary Nelapatla	379131900148754	F/ 48 Yr/General/9505716877	C F M/C F M Unit 1	02	Rx	
 8	Attended	Ragamma Pulijala	379131900148029	F/ 55 Yr/General/9177137213	C F M/C F M Unit 1	02	Rx Reprint	
 3	Attended	Chittamma Kattipogu	379131900148631	F/ 75 Yr/General/8008783028	C F M/C F M Unit 1	02	Rx Reprint	
 10	Attended	Ranga Nayakulu Rasabathula	379131900148843	M/ 32 Yr/General/9290511722	C F M/C F M Unit 1	02	Rx Reprint	

Doctor Desk LITE Prescription Entry Interface

Rx Prescription [C F M / C F M Unit 1]



fgfdhghghfgjllkjsakldaskjldkaskjksja (F/ 45 YR/GENERAL/6576768787891) CRN : 35676576875878798989



Attended

Vitals & General Examination :

Wt. : 60.00 kgs

Ht. : 152.00 cms

BMI : 25.97

BP : 114.0/84.0 mm/HG

Temp : 0.00 F

B.S.Fast:0.00 mg/dL

B.S. PP : 0.00 mg/dL

HBA1C: 0.00 %

Past Rx

History

Modify Vital/GE

Chief Complaint :   Health screening x

Chief Complaint



Side



No.

Days



Remarks

Add

Enter History Of Present Illness:



+ Complete History

+ Examination

+ Chronic Disease

☰ Rx ▾

Taxonomy Search

Taxonomy

- ▼ SNOMED CT Concept
 - ▶ Body structure (body structure)
 - ▶ Clinical finding (finding)
 - ▶ Environment or geographical location (environment / location)
 - ▶ Event (event)
 - ▶ Observable entity (observable entity)
 - ▶ Organism (organism)
 - ▶ Pharmaceutical / biologic product (product)
 - ▶ Physical force (physical force)
 - ▶ Physical object (physical object)
 - ▶ Procedure (procedure)
 - ▶ Qualifier value (qualifier value)
 - ▶ Record artifact (record artifact)
 - ▶ Situation with explicit context (situation)
 - ▶ SNOMED CT Model Component (metadata)
 - ▶ Social context (social concept)
 - ▶ Special concept (special concept)
 - ▶ Specimen (specimen)
 - ▶ Staging and scales (staging scale)
 - ▶ Substance (substance)

Concept Details

Concept Details

Summary Details Diagram

Parents
No parents

● SNOMED CT Concept (SNOMED RT+CTV3)

SCTID: 138875005

138875005 | SNOMED CT Concept (SNOMED RT+CTV3) |

SNOMED CT Concept (SNOMED RT+CTV3)

SNOMED CT Concept

SNOMED CT has been created by combining SNOMED RT and a computer-based nomenclature and classification known as Read Codes Version 3, which was created on behalf of the U.K. Department of Health.

SNOMED Clinical Terms version: 20160731 [R] (July 2016 Release)

Children (19)

- ▶ Body structure (body structure)
- ▶ Clinical finding (finding)
- ▶ Environment or geographical location (environment / location)
- ▶ Event (event)
- ▶ Observable entity (observable entity)
- ▶ Organism (organism)
- ▶ Pharmaceutical / biologic product (product)
- ▶ Physical force (physical force)
- ▶ Physical object (physical object)
- ▶ Procedure (procedure)
- ▶ Qualifier value (qualifier value)
- ▶ Record artifact (record artifact)

SNOMED / ICD-10 Diagnosis Entry

SNOMED/ICD 10
Toggle

Diagnosis Type

DIAGNOSIS :

ICD Code SNOMED-CT

fev|

- FEVC
- Fever
- Q fever
- FEV Time
- Feverfew
- Hay fever
- FEV normal

Diagnosis Type

Diagnosis Entry with EHR Standards Compliance


DIAGNOSIS : 

ICD Code SNOMED-CT

- FEVC
- Fever
- Q fever
- FEV Time
- Feverfew
- Hay fever
- FEV normal

Diagnosis Type

Reports

DIAGNOSIS : 

ICD Code SNOMED-CT

ICD Code Search

Enter Other Diagnosis

- Fever** of unknown origin
- Fever** with chills
- Fever**, unspecified
- fever**: · Malta · Mediterranean · undulant

Diagnosis Type

Drug & Procedure Rx Based on EHR Standards

Drugs from hospital drug list
(To comply with SNOMED CT Drug Terminology for India in future)

DRUGS/ADVICES :

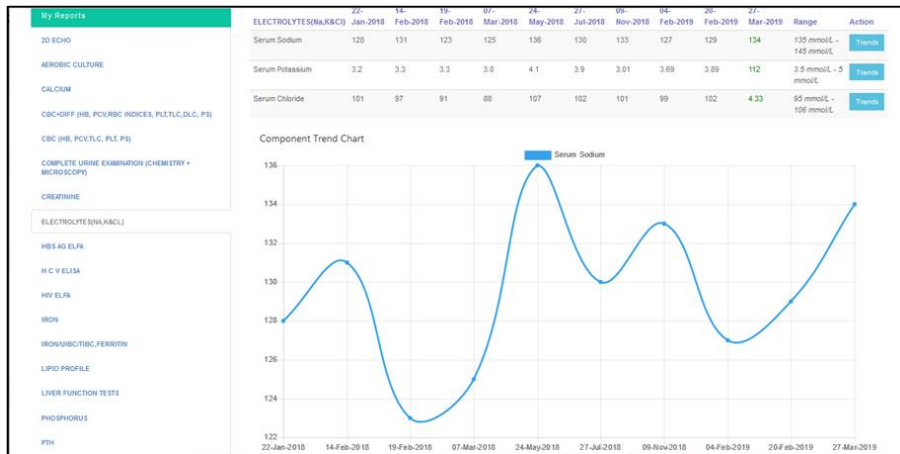
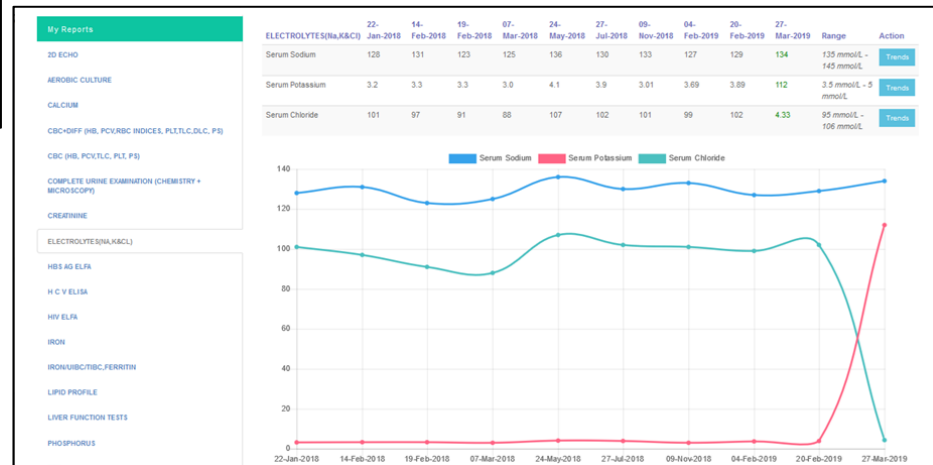
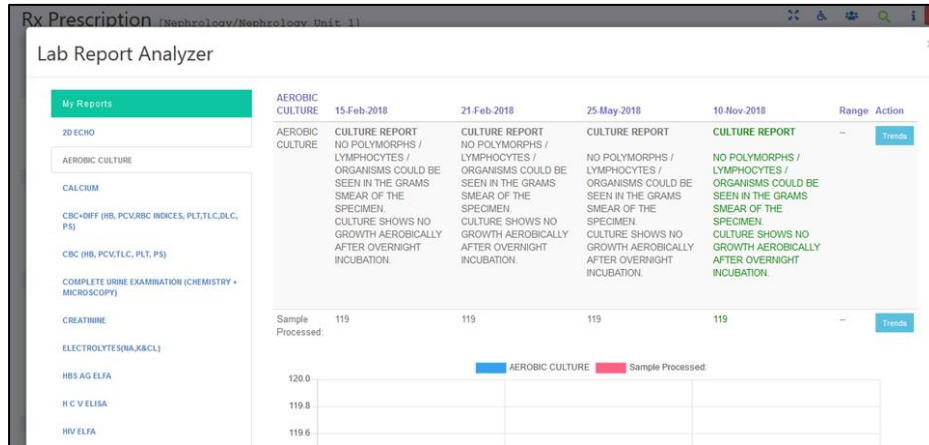
Drug	Dosage	Frequency	Start Date	Days	Quantity	Instructions	Change
para	2 Drops	OD	03/29/2019				Add
PARACETAMOL (150MG/ML) 2ML INJ							
PARACETAMOL IV 1GM							
PARACETAMOL 60 ML							
PARACETAMOL 500MG							
PARACETAMOL 650MG							

Labels for Drug Form: Dosage, Frequency, Start Date, No. of Days, Quantity, Instructions

Procedures :

Clinical Procedure	Side	Remarks	Add
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Lab Reports Trends Analyzer (LOINIC)



Lab Results History & Trend Analyzer on Mobile/Tabs

Doctor's Desk Demo

Patient Details
 CR No: 331011700087206
 Name: B Sudhakar (38 Yr/Male)

Glucose Fasting

Plasma Glucose (Fasting) Chart View

Name	Range	Value
15-Feb-2019	70 mg/dL - 100 mg/dL	94

BACK

Doctor's Desk Demo

Patient Details
 CR No: 331011700087206
 Name: B Sudhakar (38 Yr/Male)

Activated Partial Thromboplastin Time (APTT)

AEROBIC CULTURE

ANCA IMMUNO FLUORESCENCE

BU/SC/SE

Calcium

CBC (HB, PCV,TLC, PLT, PS)

COMPLETE URINE EXAMINATION (CHEMISTRY + MICROSCOPY)

CREATININE

BACK

Doctor's Desk Demo

Patient Details
 CR No: 331011700087206
 Name: B Sudhakar (38 Yr/Male)

Click to see trends

Lab Reports:

Test Name: HBS Ag ELFA
 331011000419021710005401
 Report Date: 2019-02-18 12:00:33.0

Test Name: H C V ELISA
 331011000419021710005403
 Report Date: 2019-02-18 12:00:33.0

Test Name: HIV ELFA
 331011000419021710005402
 Report Date: 2019-02-18 12:00:33.0

Test Name: ANCA IMMUNO FLUORESCENCE
 331011000419021510023801
 Report Date: 2019-02-16 18:00:34.0

BACK

Doctor's Desk Demo

Patient Details

Serum Creatinine

Date	Value
14-Feb-2019	2.19
15-Feb-2019	2.05

CLOSE

BACK

History

X

- Profile
- Vitals / GE
- History
- Examinations
- Allergies
- Chronic Diseases
- Chief Complaint
- Diagnosis
- Investigations
- Clinical Procedures
- Treatment Advices
- Drug/ Advices
- Patient Ref.

PATIENT CLINICAL DATA

Print

Name	Yashraj Rajanujaysia	CR No.	689699898980
Department (Unit)	C F M/C F M Unit 1	Reprinted On	31-Oct-2019 / 10:13:44
Mobile No	9849957894 768859699	Occupation	-

31 Oct, 2019 (C F M/C F M Unit 1)

HOPI : K/C/O of T2 DM since 1 year using Glucoryl M2 once in two days, FBS-274, PPBS-460, Urine glucose 2+, traces of albumin + and plenty of pus cells in urine
 Lipid profile- deranged, CBC- Normal and thyroid profile- normal, , Albumin-5, BUN-10.65, Urea-22.8, creatinine-0.4

26 Oct, 2019 (C F M/C F M Unit 1)

HOPI : Urge and stress incontinence - Associated with increased frequency in micturition, no h/o burning micturition, No h/o fever

Surgical History : Abdominal hysterectomy - 18 years back

Personal History : bowel movements regular, sleep disturbed

Treatment History : irregular? medication for diabetes- alternate day

Past History : has h/o stress incontinence once in a while, has hip pain radiating to thigh since childhood, right side limb short than left side



OPD PRESCRIPTION

Name	Chandrasekhar	CR No.	31043404343
Age/Gender	75 Yr/F	Patient Category	General
Father/Spouse Name	Nanaiah	Department (Unit)	C F M/C F M Unit 1
Visit Date	31/10/2019	Consultant Name	Dr. Navya Krishna Naidu
Mobile No.	8008783028	Occupation	-

CHIEF COMPLAINT : Giddiness(2 Months) , SOBOE - Shortness of breath on exertion(2 Months) , Burning sensation(2 Months) ,

HISTORY OF PRESENT ILLNESS : K/C/O T2DM and HTN, No medications or records brought by patient.

VITALS/GE : Weight : 47.00KG., Height : 149.00CM, BMI : 21.17CM, BP :145.0/80.0mmHg, Temperature : 0.00F, B.S. Fast : 0.00mg/dl, B.S. PP : 0.00mg/dl, HBA1C : 0.00mg/dl,

DIAGNOSIS : Diabetes mellitus(Provisional .), HTN - Hypertension(Provisional .),

INVESTIGATIONS ADVISED :

1) HbA1c (T27) , 2) UREA (URE) , 3) Serum Creatinine (SC) , 4) CBC* , 5) ECG (ECG) , 6) Urine Routine (UR) ,

To review with reports

TREATMENT ADVICE : Diabetic diet advised

Rx

1. METHYLCOBALAMINE-750MG+PREGABALINE-75MG, One Tablet, HS, 30 Days, (After Food at bed time)

CLINICAL NOTE : To bring old medical records/medications using by pt. To come on fasting for lipid profile/FBS/PPBS test on next visit

No Known Drug Allergy

FOLLOW UP :

Signature of Consultant

Dr. Navya Krishna Naidu



Patient Uploaded Prescription Image Viewing

	4	Attended	B Venkanna	331011900384124	M/ 45 Yr/Tgarsr	Nephrology/Nephrology Unit 1	16	Rx	Reprint
	5	Attended	Ch Veerabhadram	331011701020415	M/ 41 Yr/Tgarsr	Nephrology/Nephrology Unit 1	16	Rx	Reprint
	6	Attended	Ganesh	331011801183532	M/ 10 Yr/Tgarsr	Nephrology/Nephrology Unit 1	16	Rx	Reprint P
	7	Attended	M Komariah	331011900371472	M/ 70 Yr/Tgarsr	Nephrology/Nephrology Unit 1	16	Rx	Reprint
	8	Attended	R Shankar	331011801208551	M/ 47 Yr/Paying	Nephrology/Nephrology Unit 1	16	Rx	Reprint

Rx Prescription [Nephrology/Nephrology Unit 1]

(CH VEERABHADRAM) << **GANESH (M/ 10 YR/TGARSR) CRN : 3310118011835**

Attended

Chief Complaint :

Prescriptions -

Enter Chief Complaint

Add

DIAGNOSIS :

ICD Code SNOMED-CT

Enter Diagnosis

Diagnosis Type

Add

INVESTIGATIONS : Uric Acid SERUM UREA ELECTROLYTES(Na,K&Cl) CBC (HB, PCV,TLC, PLT, PS) more..

CREATININE Liver Function Tests

Reports

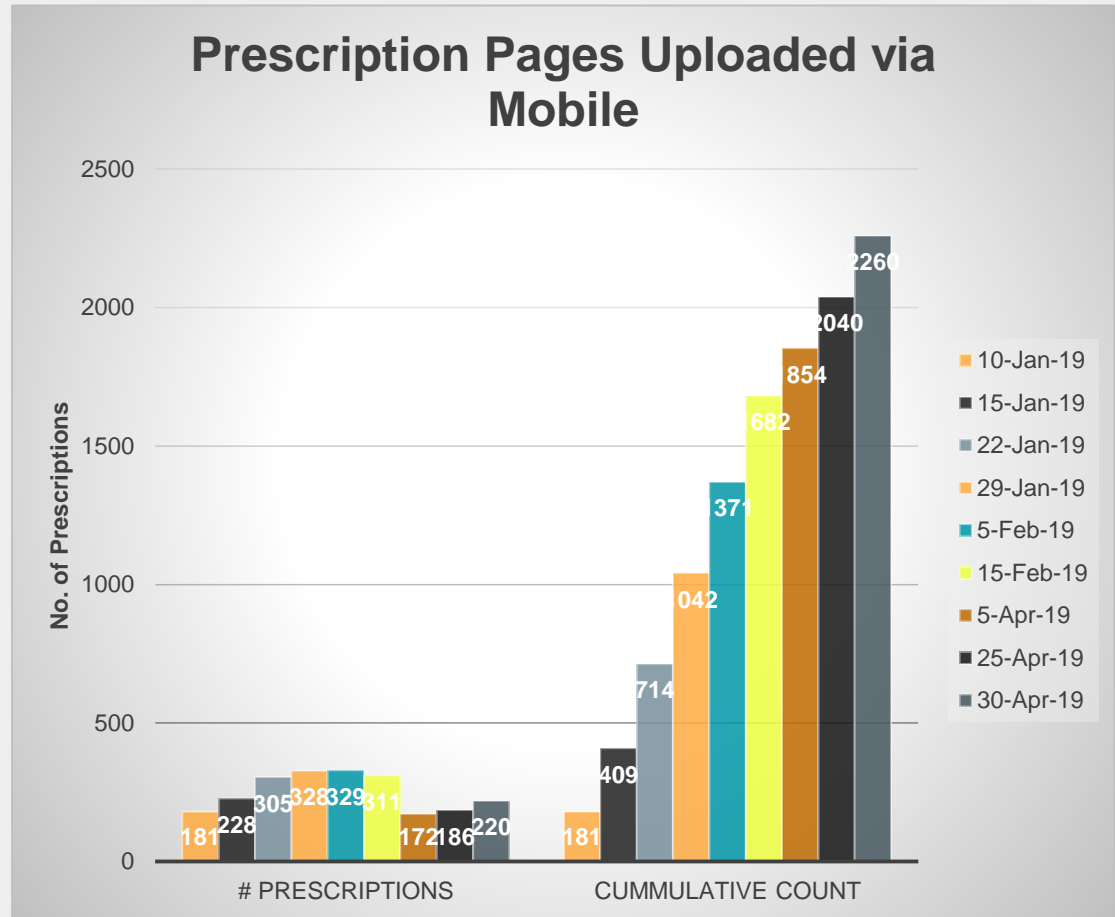
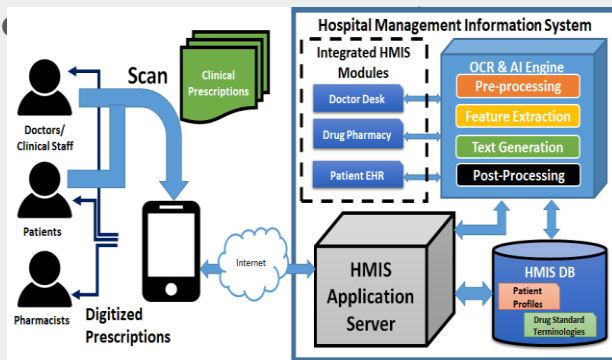
Medical Genetics M H D Investigations

Enter Test Name

Add

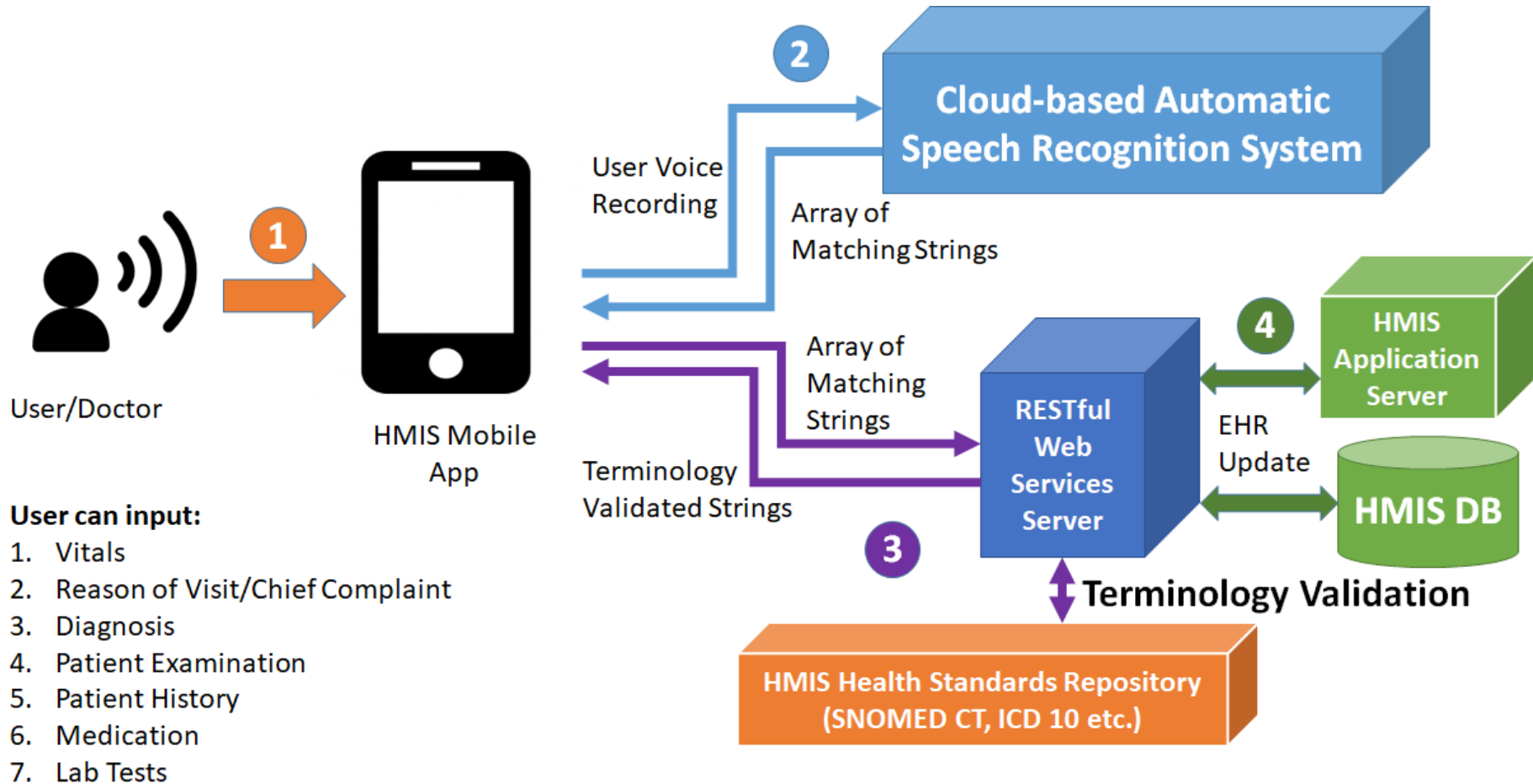
Prescription Scanning & Upload–Case Study at NIMS, Nephrology Department

- Prescription Scanning was implemented in NIMS, Hyderabad
- During a 4 month period, 2,200+ prescription images (up to 3 per visit) were uploaded by doctors/assistants.



Prescription Scanning with AI Assisted Digitization using OCR

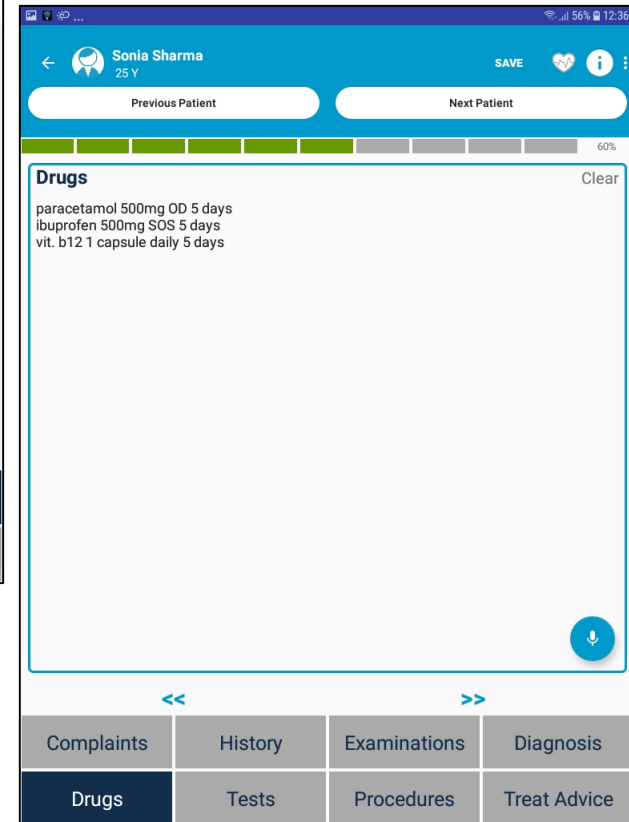
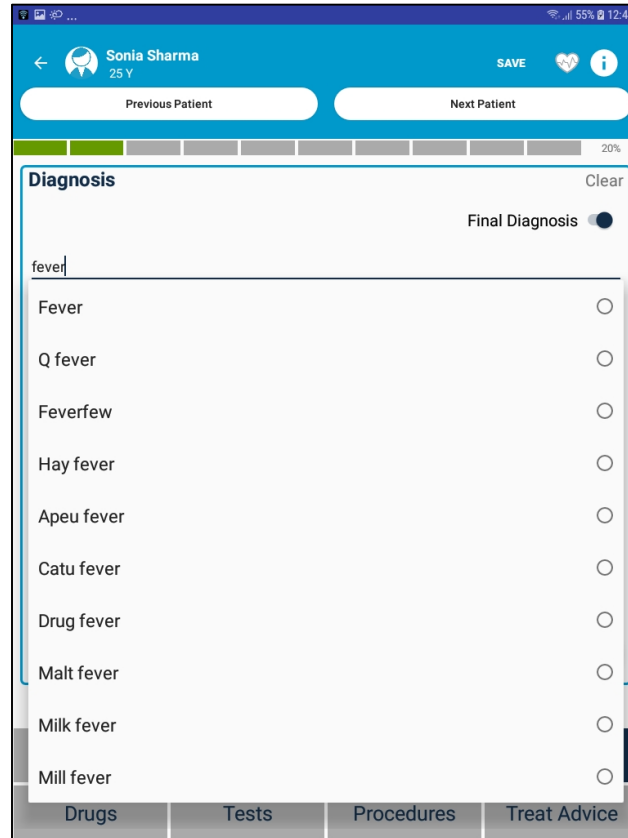
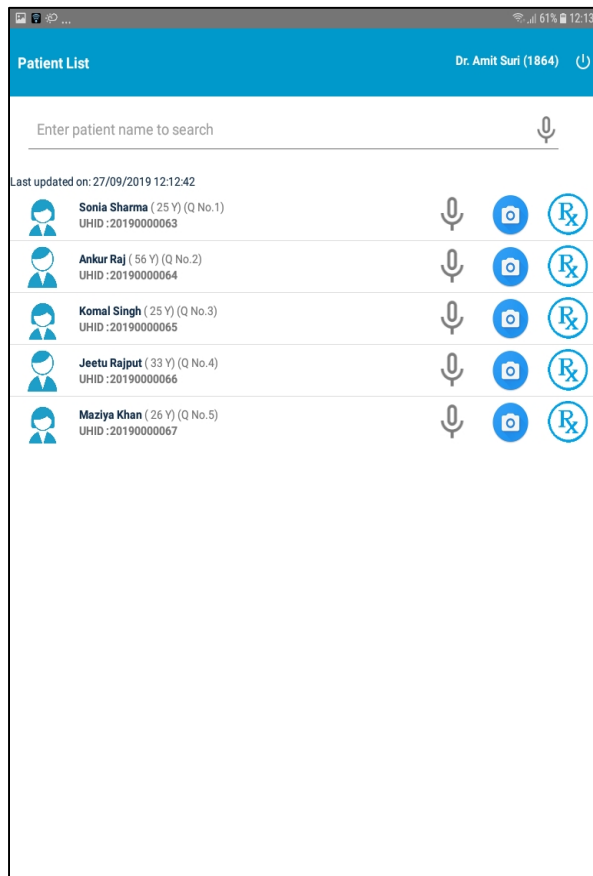
Voice-Based Prescription Generation System



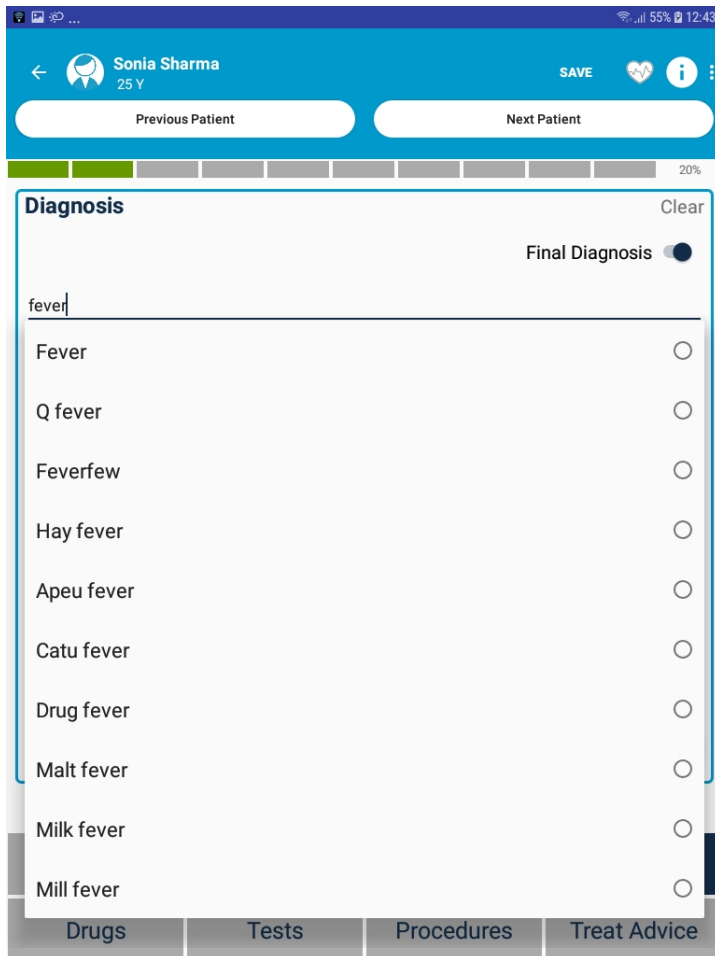
User can input:

1. Vitals
2. Reason of Visit/Chief Complaint
3. Diagnosis
4. Patient Examination
5. Patient History
6. Medication
7. Lab Tests

Mobile/Tablet based interfaces With Voice Support



SNOMED-CT Terminology Compliance



- The voice-to-text Doctor Desk app allows for entering SNOMED CT Terminology for diagnosis and other prescription fields.
- Clinician uses voice to input initial field data.
- Dropdown lists populates with matching SNOMED terms.
- Clinician can select the appropriate term from the list.
- This solution provides an alternative approach to clinical data entry via voice which is standard compliant as opposed to conventional methods of keyboard-based input.
- Voice-based interfaces allow for convenience of clinicians for providing input on tablets/mobile devices.

Findings from an Implementation Case Study

The Doctor Desk LITE was implemented at the following hospitals:

1. All India Institute of Medical Sciences, Manglagiri
2. All India Institute of Medical Sciences, Raibareilly
3. All India Institute of Medical Sciences, Nagpur
4. All India Institute of Medical Sciences, Patna
5. All India Institute of Medical Sciences, Raipur
6. Nizam's Institute of Medical Sciences
7. Telangana State – Gandhi Hospital
8. Odisha state-wide implementation (Capital Hospital, Bhubaneswar)

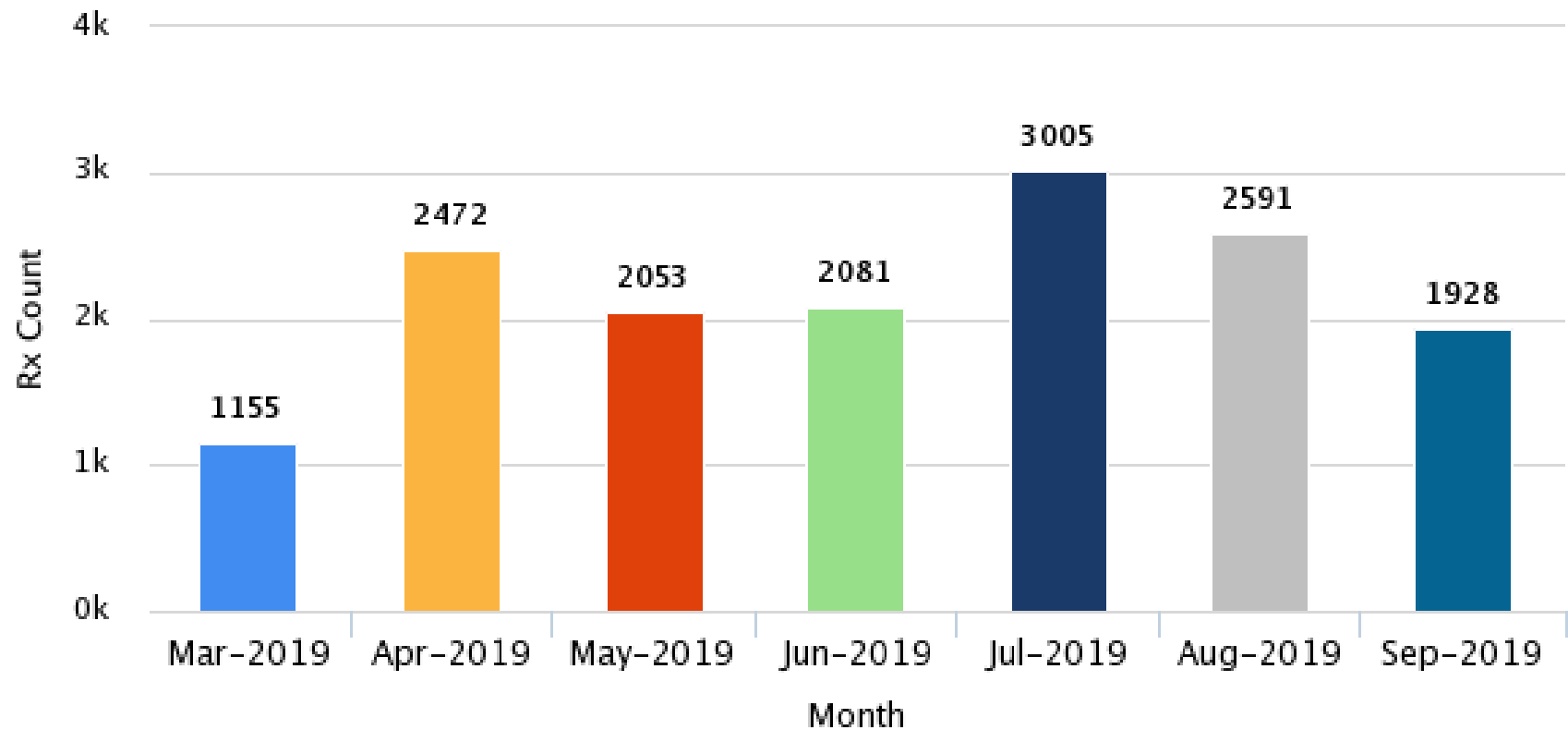
AIIMS Mangalagiri

Case Study Report

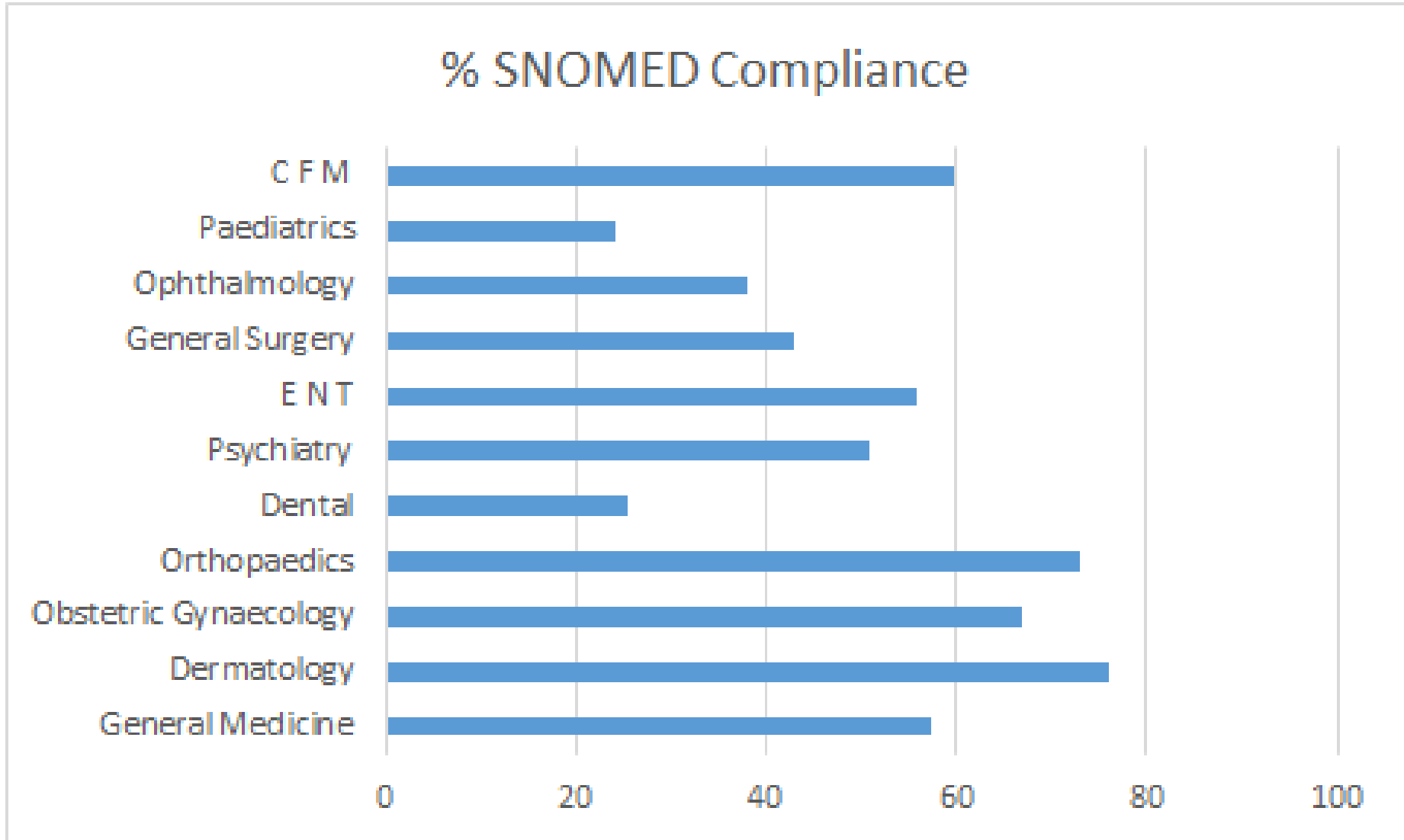
Patient e-Rx Recorded

Month-wise Rx Count

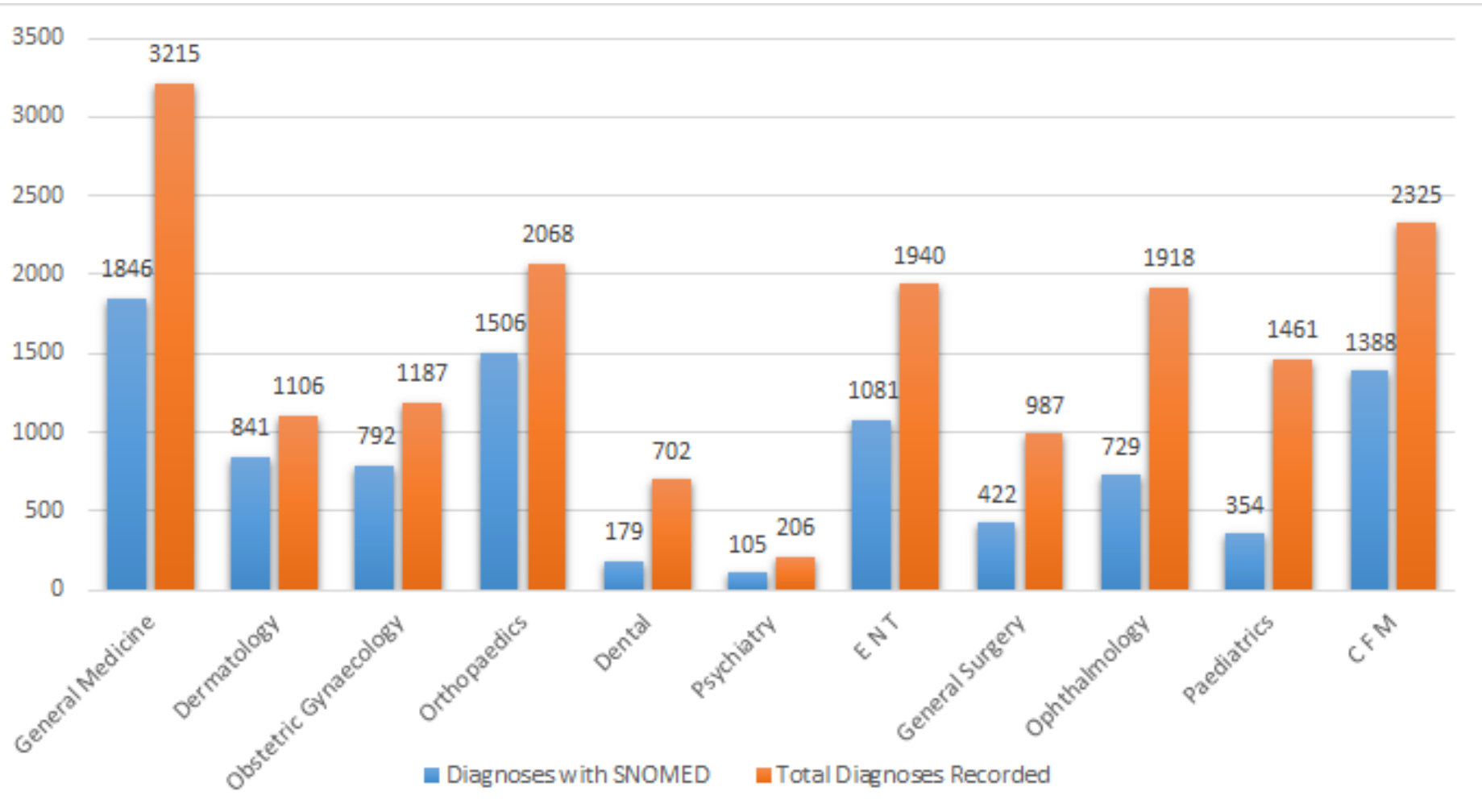
Run Date:23/10/2019 14:22:04



Compliance with SNOMED-CT Entry in Prescriptions



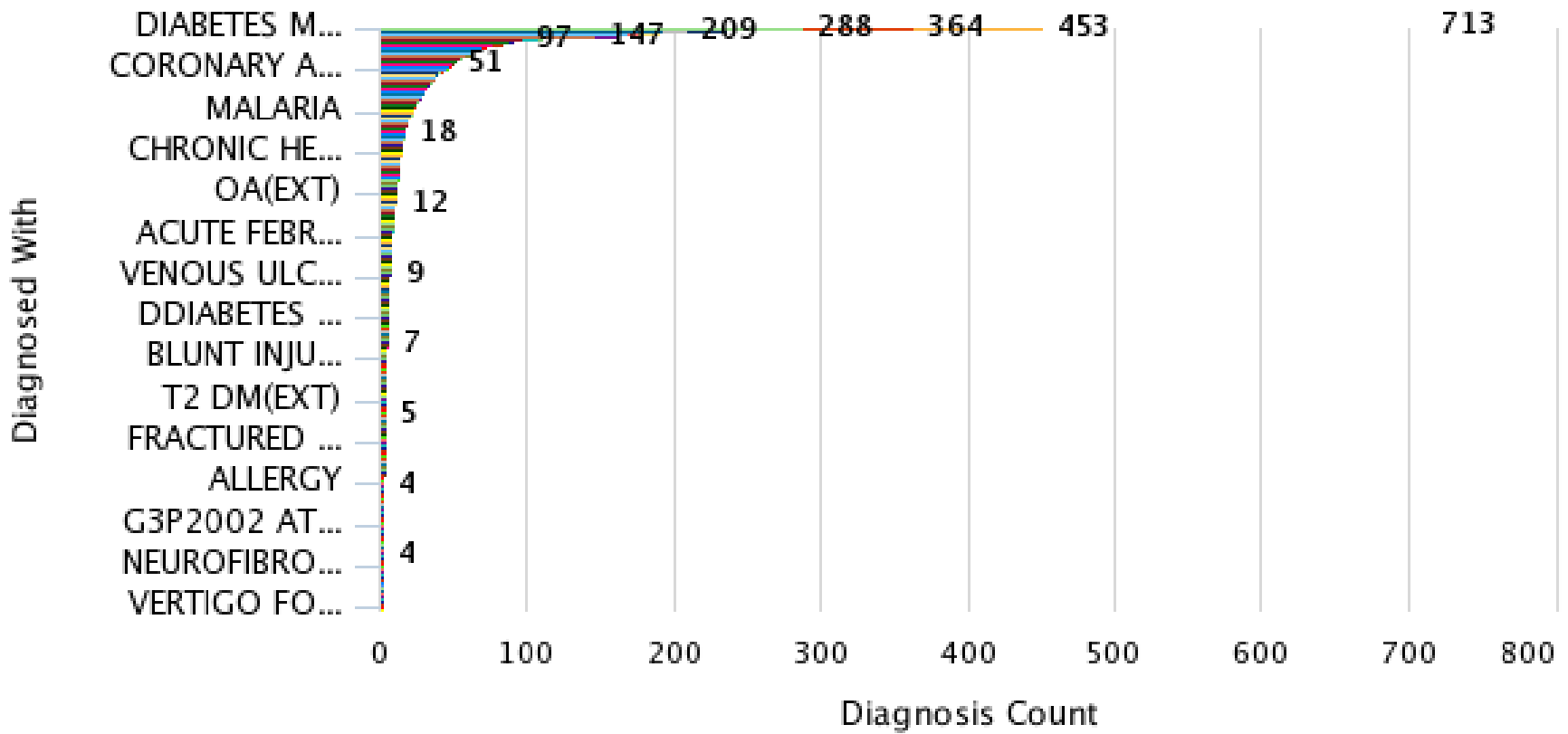
Compliance to use of SNOMED Concepts in Recording Diagnoses



Distribution of Patient Diagnoses

Total Patients Diagnosis Count

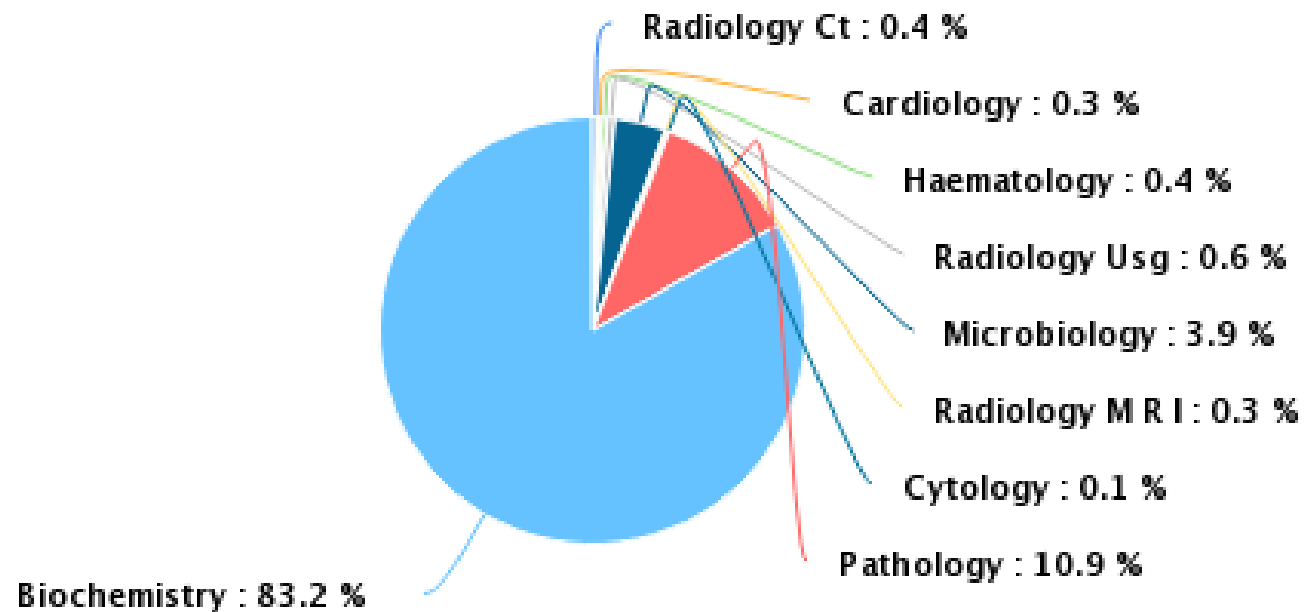
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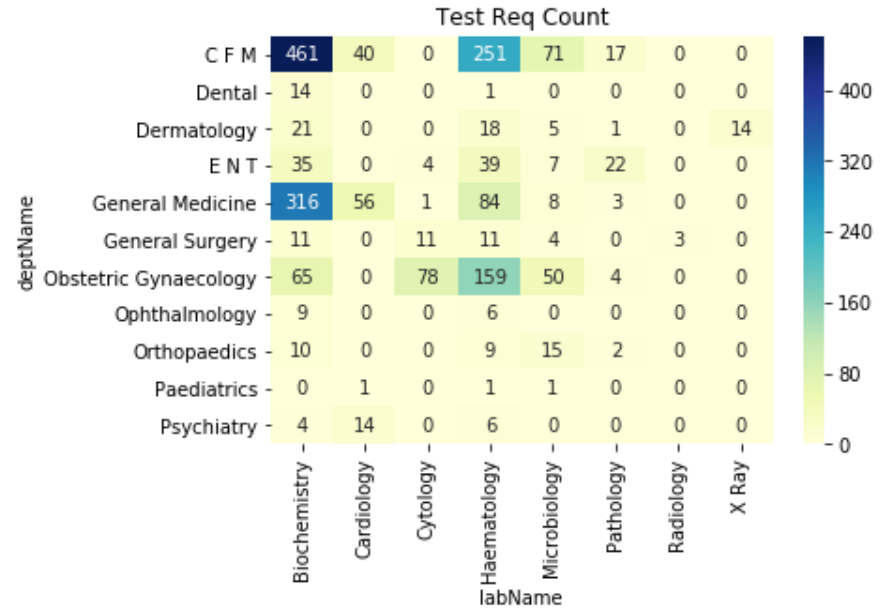
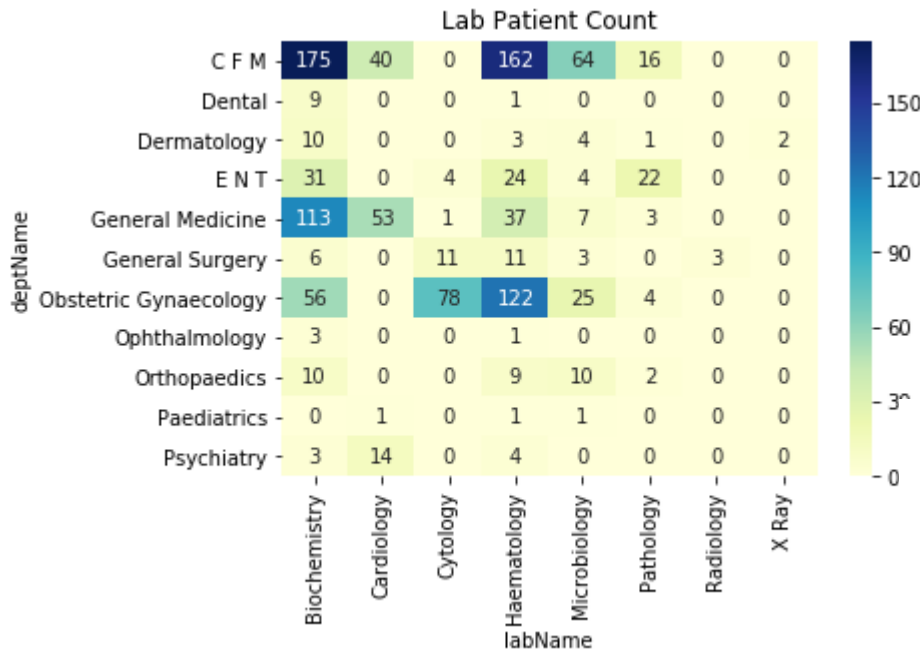
Lab Test Requisitions Raised

Lab Wise Total Requisition Raised

Run Date:23/10/2019 11:20:44



Lab Patient Count and Requisitions Raised



Conclusions and Future Work

1. Doctor Desk^{LITE} has been proposed as a comprehensive solution for facilitating clinical data entry, including data compliant with SNOMED CT.
2. Multiple live implementations have shown that clinical data entry has significantly improved as a result of using the Doctor Desk^{LITE}.
3. Interfaces for prescription entry using voice on mobile devices has also helped in ease of clinical data entry for physicians.
4. Future work involves increasing scope of standard compliance in developed solutions and facilitating widespread adoption.
5. Artificial Intelligence & Machine Learning for healthcare Decision Support System. Blockchain based EHR platform for patients
6. Integration with interoperability frameworks such as Continuity of Care Document (CCD) and HL7 messaging would also enhance adoption of EHR standards.

